June 18, 1940. E. K. HANSEN, 2,205,258

PROTECTION FOR CONTROLLED ATMOSPHERE FURNACES

Filed Nov. 15 1939 3 Sheets-Sheet 1

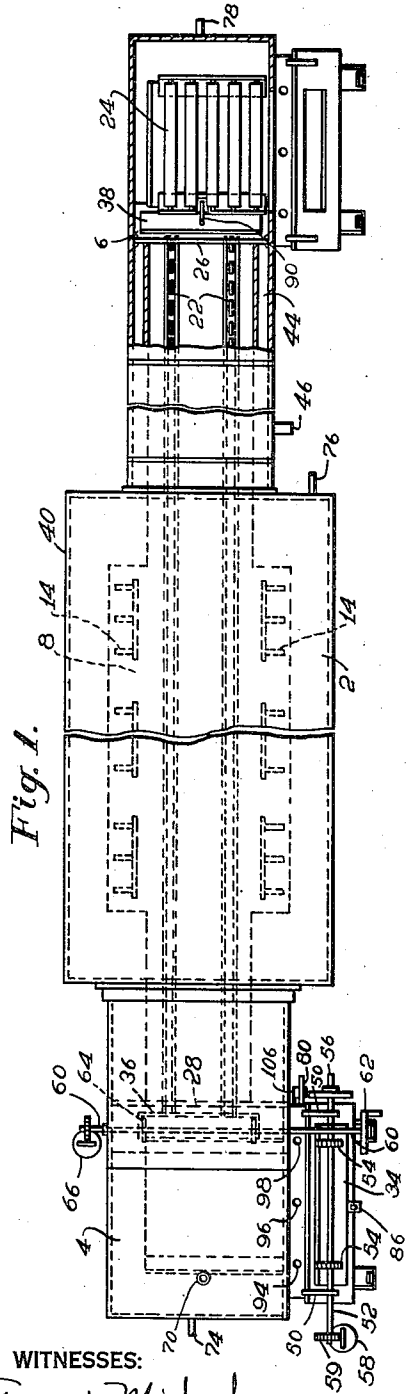


Fig. 1.

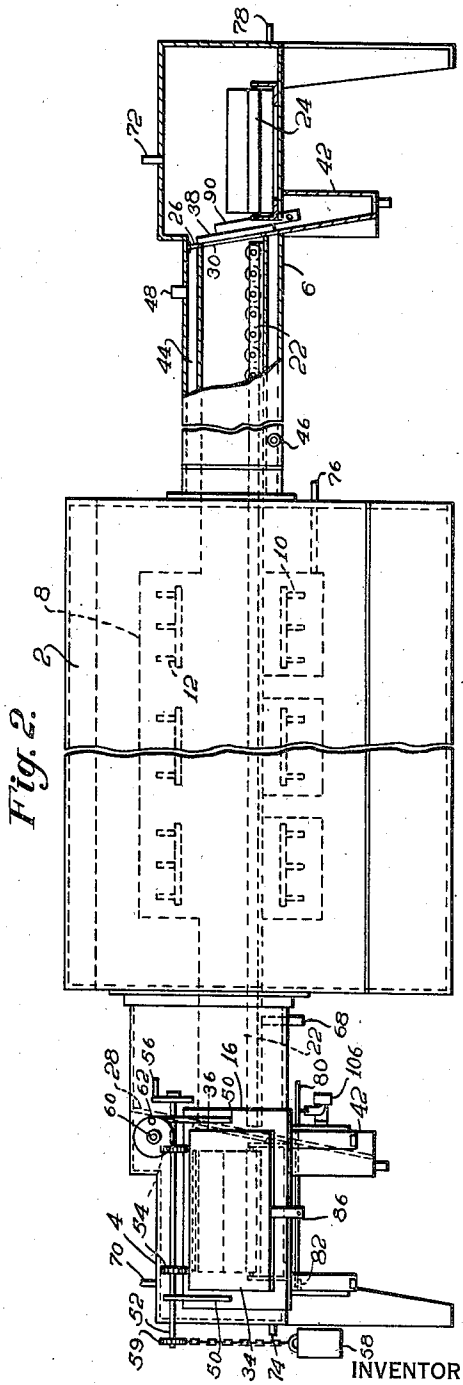


Fig. 2.

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PROTECTION FOR CONTROLLED ATMOSPHERE FURNACES

Filed Nov. 15, 1939 3 Sheets-Sheet 2

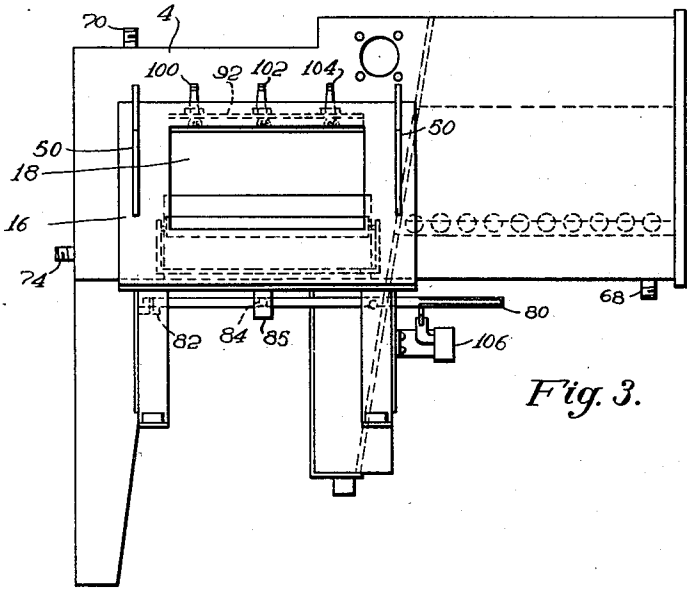


Fig. 3.

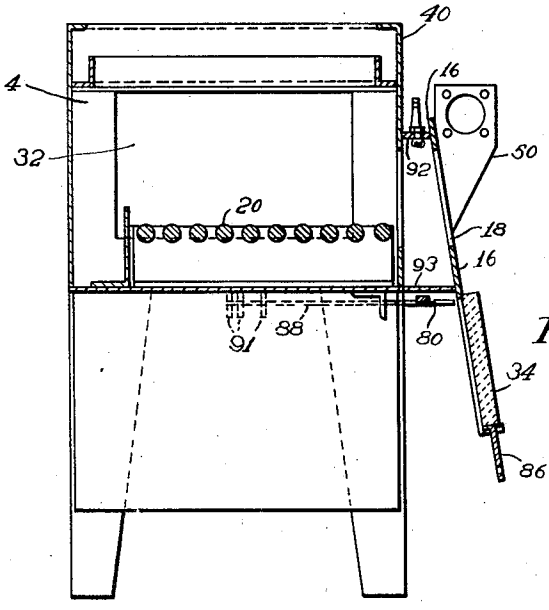


Fig. 4.

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PROTECTION FOR CONTROLLED ATMOSPHERE FURNACES

Filed Nov. 15, 1939 3 Sheets-Sheet 3

Fig. 5.

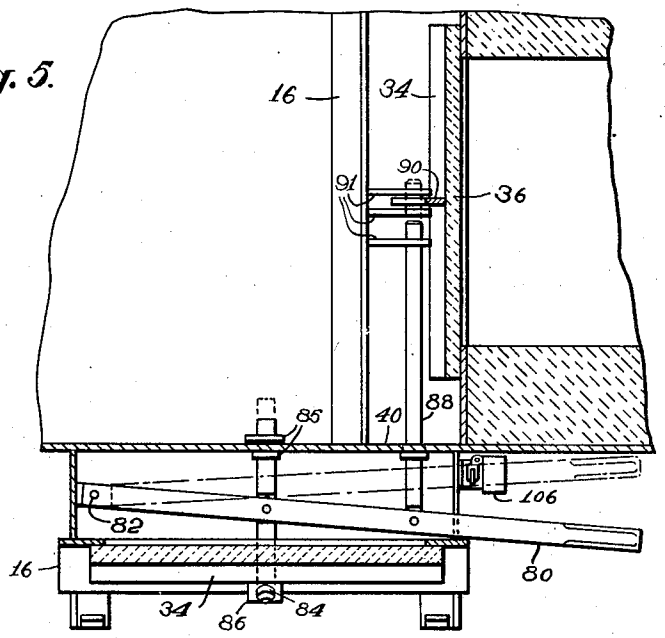


Fig. 6.

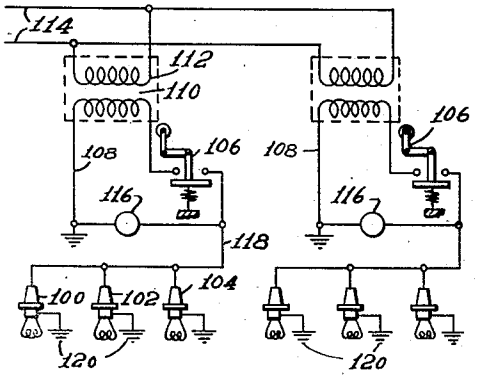
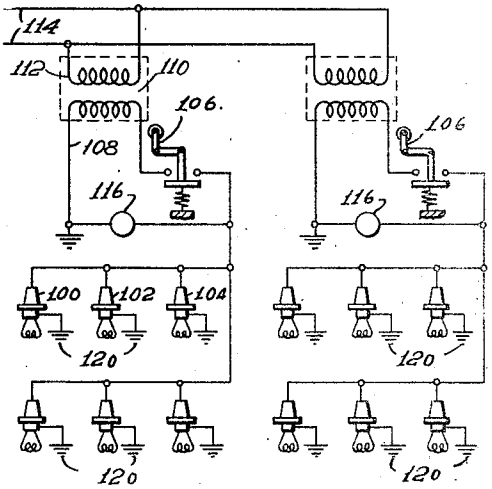


Fig. 7.



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UNITED STATES PATENT OFFICE

2,205,258

PROTECTION FOR CONTROLLED ATMOSPHERE FURNACES

Elmer K. Hansen, Edgewood, Pa., assignor to Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., a corporation of Pennsylvania

Application November 15, 1939, Serial No. 304,528

5 Claims. (Cl. 266—5)

My invention relates generally to electric furnaces of the type employing special atmospheres permeating the chambers therein for enveloping the charge being heat treated.

Such furnaces are now in common use for many heat-treating processes such as, for example, brazing, hardening of tool steels, bright annealing, nitriding, and the like. Among the most common protective atmospheres now used in such environments are hydrogen, dissociated ammonia, and reducing gases usually containing large percentages of carbon monoxide and obtained by the partial combustion and treatment of natural gas, or illuminating gas, or other similar commercially available combustible gases. These gases are as a rule combustible and when mixed in proper proportions with air are explosive so that there is always a danger of an explosive mixture existing in a heat-treating furnace, and especially so during the insertions and removals of the charges, unless precautionary or preventive measures are taken.

Accordingly, it is an object of my invention to provide a furnace which has protective features which render it safe from the hazards of explosion.

Another problem faced in the operation of a furnace of the type described is the infiltration of air into the furnace during the insertions and removals of the charges, which air contaminates the protective atmosphere with possible deleterious results to the articles being heat-treated. In accordance with my invention, I provide means for confining infiltration of air to definite furnace chambers and further assure the burning of the protective gases along the line of contact with the incoming air so that the oxygen in the air is fully consumed by the resulting combustion with the creation of oxides which can be subsequently purged before the charge is advanced to the heating chamber in the customary operation of the furnace.

In a particular embodiment of my invention, I employ a furnace having a heating chamber in the furnace proper, with a separate entrance or charging chamber at one side of the furnace in communication with the heating chamber, and which might also serve, if desired, as an exit or discharging chamber, but in the embodiment to be described, this last function is performed by a separate discharging chamber. Both the charging chamber and the discharging chamber are provided with the protective features of my invention and are essentially similar so that the pertinent description of my invention although hereinafter confined largely to one of them is, in reality, applicable to both.

The charging chamber has, of course, a charge-entrance or outer door, while an intermediate door separates this chamber from the heating zones of the furnace. I provide door-operating means so interlocked that one or the other of the doors only can be opened, that is, the interlock is such that the outer door can be opened only while the intermediate door is locked in closed position, and vice versa, the intermediate door can be opened only while the outer door is locked in closed position. Electric igniting means are provided at the entrance opening to the charging chamber operable when the outer door is capable of being open, these igniting means assuring ignition of the gas mixture which occurs as the air enters into the chamber, due to the opening of the outer door, and mingles with the combustible protective atmosphere. By providing the interlocked doors, the entering air cannot progress beyond the entrance chamber and into the heating chamber. This feature has the added value of preventing any explosive mixture of air and combustible gas from contacting the hot interior of the heating zones. The operation just described is, of course, essentially the same for the discharge chamber.

To further complete the protective features of my invention, and also in the interests of economy, the door interlocking and operating means controls the application of energy to the ignition means so that it is energized just prior to the opening of the entrance door, and is maintained energized until the outer door is again locked closed.

Other features, objects and details of my invention will be apparent from the following description thereof, taken in connection with the accompanying drawings, in which the essential elements of my invention are more particularly shown. In these drawings;

Figure 1 is a plan view, partly in section, of a furnace embodying my invention;

Fig. 2 is an elevational view, partly in section, of the furnace;

Fig. 3 is an enlarged, elevational view of the charging chamber of the furnace with the outer door and door-operating mechanism removed, but showing an operating lever by means of which the doors are interlocked;

Fig. 4 is a transverse, vertical, sectional view of the structure of Fig. 3, with part of the outer door shown;

Fig. 5 is an enlarged, horizontal, sectional view

of part of the chamber shown in Fig. 3 showing the door interlocking mechanism in greater detail; and

Figs. 6 and 7 are schematic wiring diagrams of two embodiments of electric circuits for energizing the igniting means which ignites the layer of protective atmosphere in contact with the incoming air when an outer door is opened.

While my invention is generally applicable to any suitable furnace, for the purpose of disclosing one embodiment thereof I have chosen a furnace having a main heating chamber 2, and two end chambers in the form of a charging chamber 4, and a cooling and discharging chamber 6.

The main heating chamber is constructed in any suitable manner and comprises, generally, the customary insulating and refractory walls defining a heating zone 8 in which are disposed suitable electrical heating elements, the bottom heating elements being represented by the numeral 10, the top heating elements being represented by the numeral 12, and the side-wall heating elements by the numeral 14.

As shown more particularly in Figs. 1, 2, 3 and 4, the charging chamber is provided with an outer door frame 16 having an opening 18 through which charges are inserted. A suitable roller floor 20 is provided on which the charge rolls during its insertion.

Roller rails 22 are provided throughout the length of the furnace between the charging and discharging chambers so that a charge deposited on the rolls may be pushed by the usual pusher rod through the various zones of the furnace at appropriate times in the heat-treating process. In the discharge chamber an additional roller floor 24 is provided for the reception of charges coming off the roller rails 22, from whence the charge may be pushed by any suitable pusher rod provided in the furnace through an opening in a door frame of the discharge chamber constructed and arranged similar to the door frame of the charging chamber.

Suitable doors may be provided for defining different zones within the furnace, but for the purpose of my invention it is sufficient to describe outer doors for the end chambers and two intermediate doors, one for each chamber which separates them from the rest of the furnace.

The charging and discharging chambers are separated from the remaining parts of the furnace through separating means 26 between the discharging chamber and the remainder of the furnace, and similar separating means 28 between the charging chamber and the remainder of the furnace, these separating means usually comprising suitable metallic structure having an opening through which the charges may pass in traversing the furnace, the opening for the discharge separating means being indicated at 30, and that for the charging means being indicated at 32.

Accordingly, it may be perceived that there are two outer openings in the furnace through which the charge is inserted and removed; the charge being inserted through the opening 18 in the charging chamber structure and being withdrawn from the corresponding opening in the discharging chamber structure. Additionally, there are at least two openings within the furnace through which the charge passes in going from the charging chamber to the discharging chamber, one of the openings being indicated at 32 in the separating means 28, and the other opening being indicated at 30 in the separate means 26. To control these openings, an outer door 34 is provided for the outer opening 18 and a similar door is provided for the outer discharge opening. Intermediate doors 36 and 38 are provided for the intermediate openings 32 and 30, respectively. All doors are of the type which expose the door openings when the doors are lowered, and close the openings when the doors are raised.

My invention is applicable primarily to furnaces employing protective atmospheres, and to this end the entire furnace is preferably encased in a gas-impervious metallic shell 40 in the customary manner. The shell includes depending portions 42 into which the intermediate doors drop when the intermediate openings are to be exposed for the passage of charges and they are, therefore, entirely within the metallic shell of the furnace.

A cooling zone in the form of a water jacket 44 may be further provided at the discharge end of the furnace, extending for a predetermined length away from the heating zone, this water jacket having a water inlet pipe 46 and a water outlet pipe 48.

The operating means for each of the outer doors comprises a pair of brackets 50 secured to the door frame 16 along its top and disposed at each side of the opening 18. A rotatable shaft 52 extends through suitable apertures in the brackets 50 and has sprocket wheels 54 engaging chains suitably secured to the top of the outer door 34. One end of the shaft 52 is provided with a crank 56 for raising and lowering the door, and the other of the shaft has a counterweight 58 secured to a sprocket chain meshing with a sprocket 59 on the shaft 52 for balancing the weight of the door.

The door-operating mechanism for each of the intermediate doors comprises a rotatable shaft 60, extending through suitable gas-tight packing glands in the shell 40, which is also provided with a crank 62, so that the intermediate door may be raised and lowered through the medium of suitable chains secured to the top of the door and engaging sprocket wheels 64 inside the furnace and on the shaft 60. A counterweight 66 serves to balance the shaft 60 with respect to the intermediate door.

In order to permeate the furnace with the protective atmosphere a suitable gas inlet 68 extends through the furnace shell in a gas-tight manner and discharges the protective atmosphere in proximity to the heating zone. An additional gas inlet 70 is provided for the charging chamber and a gas inlet 72 is provided for the discharging chamber. In practically all such furnaces the protective atmosphere is admitted to the furnace under pressure so that a plenum system obtains; that is, the gas will seek to flow out of the furnace, rather than air into the furnace, through any small crevices that might exist and which usually do exist in the joints between the different doors and their door frames or equivalent devices. However, in the event it is desired to have a large flow of protective atmosphere to the furnace, or through the different chambers of the furnace, additional gas outlet means in the form of pipes 74, 76 and 78 may be provided so that increased amounts of gas may be fed into the furnace chambers.

The specific furnace construction thus far briefly described is well known and further details thereof are not deemed necessary. However, in accordance with my invention, I first add an interlock between an outer door and its cor-

responding intermediate door, and an energizing circuit for electric ignition means disposed in proximity to the entrance opening of the outer door so that when the interlock permits the outer door to be opened, the electric ignition means will ignite the mixture of gas and air that will necessarily result from the inflow of air when the door is open, or in the process of being opened.

For this particular furnace, the interlock comprises a lever 80 pivoted at 82. Pivoted loosely on the lever is a protruding lug 84 of a rod guided by apertured guides 85, and adapted to enter an aperture in a plate 86 depending from the bottom of the outer door 34 when the lever is in a position to lock this door closed. Also pivotally secured to the lever 80 is a rod 88 extending, with gas-tight provisions, through one side of the shell 40 into the depending portion 42 of the furnace and is adapted to enter into a suitable aperture in a plate 90 secured to the back of the intermediate door with a depending portion in which the aperture is located. Fixed guiding devices 91 are also suitably secured within the furnace to maintain the rod 88 in alignment during its movement.

In the operation of the interlocking means, if the lever 80 is moved to the full line position shown in Fig. 5, lug 84 will enter the aperture in the plate 86 which is secured to the outer door 34 so that this door can be neither raised nor lowered. However, such movement of the lever 80 pulls the end of the rod 88 out of the aperture in the plate 90 secured to the door 36 so that the intermediate door can be raised or lowered.

With both doors closed, when the lever is pushed to the dotted line shown in Fig. 5, the rod 88 passes through the aperture in the plate 90 to lock the intermediate door while the lug 84 moves beyond the plate 86 and, therefore, releases the outer door 34 for operation. The lug 84 for the outer door must be made of sufficient length so that when the lever 80 is pushed inward, it will nevertheless remain in the aperture in the plate 86 until the rod 88 enters into the aperture of the plate 90 and passes beyond it. Once the outer door 34 is released it may be operated, and after it is lowered, and during the lowering or raising movement, the back side of the door prevents outward movement of the lug 84 and therefore of the lever 80.

In the actual construction of the furnace I prefer to make the plate 90 of sufficient height so that when the door 36 is in lowered position any attempt to push the lever 80 inward will be unsuccessful because the end of the rod 88 will engage the solid part of the plate 90. Consequently, the outer door can never be open so long as the intermediate door is movable. It is only when the intermediate door is in raised, closed position that the aperture in the plate 90 is aligned with the rod 88.

By virtue of this interlocking mechanism, it is obvious that when an outer door is open and air flows into the charging chamber, the resulting mixture with the protective atmosphere will be prevented from flowing into the heating zone by the closed intermediate door. However, there is always the possibility that after the outer door has been closed the intermediate door might be opened before the charging chamber has been fully purged. Accordingly, I provide an igniting means making it impossible for any explosive mixture to exist in the furnace. This is accomplished by igniting the protective atmosphere and air as the two mix when the outer door is opened and air flows into the charging chamber, this igniting means being under control of the interlocking means.

Referring more particularly to Fig. 4, it may be observed that a rectangular horizontal extension connects the door frame 16 to the metallic outer shell 40, and forms part of the latter. This extension has an upper horizontal member or ledge 92 and a lower horizontal member or ledge 93, both disposed somewhat away from the corresponding horizontal edges of the opening 18. In the upper horizontal ledge 92 are formed three openings 94, 96 and 98 which are suitably threaded to receive plugs 100, 102 and 104, these plugs being in the form of the ordinary spark plug employed on automobiles but instead of having spark gaps, each is provided with a resistance across its two terminals, with one terminal, of course, being the body of the plug which is grounded in the customary manner. Plugs of this character capable of becoming hot when energized are known and the specific plug employed is a matter of choice with respect to my invention, it being only necessary that plugs be used capable of reaching a temperature above the combustion point of the mixture of air and the particular combustible protective atmosphere employed in the furnace proper.

The furnace described in Figs. 1 to 4 is such that the outer door is adapted to be lowered in order to expose the opening 18. Accordingly, with such a door the upper edge of the opening is the first to appear and as the size of the opening increases air in increasing volume flows into the charging chamber 4. However, the igniting means is in the meantime energized so that the incoming air and protective atmosphere in the charging chamber are ignited and burn. As a result, the flame may be seen to burn lazily, progressing inwardly of the charging chamber as the outer door is opened more and more. Accordingly, no explosive mixture of air and the protective atmosphere is permitted to exist in the furnace.

As a further precaution to the operation of the furnace, the energizing circuit for the different plugs is controlled by the interlocking lever 80 through the medium of any appropriate limit switch 106. When the lever is pushed inward in a manner to lock the intermediate door 36, the switch 106 is closed, thereby closing the grounded secondary circuit 108 of a transformer 110 whose primary 112 is directly connected across the power leads 114.

As may be observed in Fig. 6, when the switch 106 is closed, a circuit is completed to the signal light 116 as an indication that the circuit is in proper working condition. A second circuit is also energized through a conductor 118 to the central, insulated terminal of the plugs 100, 102, 104 whose other terminals are grounded at 120 through the metallic shell of the furnace including the horizontal ledge 92. With the connections shown, the three plugs are connected in parallel and there is a special purpose for this type of connection since I have found that although in most instances one plug would successfully ignite the combustible mixture created when the outer door is opened, by providing three plugs connected in parallel ignition of the one combustible mixture is assured even if one or two of these plugs should become defective or otherwise inoperative.

The energizing circuit to the plugs will, of

course, be maintained closed so long as the lever 80 is in the dotted line position of Fig. 1, in which the intermediate door 36 is latched closed, and the outer door 34 is capable of being opened. In other words, the igniting means is maintained energized so long as there is a possibility that the outer door may be opened either intentionally or inadvertently. However, if the lever 80 should be drawn to the position locking the outer door, and releasing the intermediate door, it is no longer necessary to maintain the igniting means energized. Accordingly, the switch 106 opens when the lever 80 is in the position when it latches the outer door.

It should be understood that the igniting means is provided for both the charging chamber and the discharging chamber because their temperatures are usually below the temperatures required to initiate combustion of a mixture of the protective atmosphere and air. Without the protective features of my invention, if the intermediate door were open while an explosive mixture existed in either of the two extreme chambers of the furnaces, the mixture might be violently exploded as it contacted or was exposed to the high heat of the heating zone.

As a result of my invention, no explosive mixture can exist in the charging or discharging chambers of the furnace. In carrying out a heat-treating process, once the outer door has been closed after the insertion into or the removal of a charge from the furnace, the particular chamber is thoroughly purged of the products of combustion resulting from the burning of the air and protective atmosphere so that when a charge is later inserted into or withdrawn from the heating chamber of the furnace, as the case may be, there is no contaminating constituent present in the enveloping atmosphere.

The plugs of Fig. 4 are shown in the upper horizontal ledge 92 of the extension because the outer door is of the type which lowers when exposing the opening 18 of the charging chamber. However, if the door were one which exposed the opening while being raised, then, manifestly the plugs should preferably be located in proximity to the lower edge of the opening 18. In Fig. 7, I disclose systems in which six plugs are provided for each opening, three to be disposed in proximity to the top side of the opening and three in proximity to the bottom side of the opening. I prefer such disposition of the plugs for furnaces employing the type of outer door which springs from the door frame in its first opening movement so that practically all four edges of the opening are exposed at the same time.

While I have shown my invention in the preferred embodiment thereof, it appears obvious that modifications can be constructed and equivalents employed.

I claim as my invention:

1. A furnace of the type in which a charge is heat-treated while enveloped by a combustible protective atmosphere and having provisions for the admission of such atmosphere, said furnace including a heat-treatment chamber, said furnace further including an opening to the outside and through which charges may be passed into or removed from said furnace, a closure for said opening, electrical resistor means capable of becoming hot when electrically energized, secured to said furnace in proximity to said opening, an electrical energizing circuit for said resistor means, and means to energize said electric resistor means when said closure is operated to open position whereby to ignite protective atmosphere and air in contact therewith flowing into said furnace through said opening.

2. A furnace of the type in which a charge is heat-treated while enveloped by a combustible protective atmosphere and having provisions for the admission of such atmosphere, said furnace including a heat-treatment chamber, an outside door for an opening in said furnace through which charges may be inserted into or removed from the furnace, a door frame for said door forming part of said furnace, electrical resistor means capable of becoming hot when electrically energized, disposed along said door frame, an operating mechanism for said door, an electrical energizing circuit for said resistor means including a control switch, said door operating means having provisions for operating said switch for energizing said resistor means while the said door is being opened whereby to ignite the protective atmosphere and air in contact therewith flowing into said furnace through said opening.

3. A furnace of the type in which a charge is heat-treated while enveloped by a combustible protective atmosphere and having provisions for the admission of such atmosphere, said furnace including a heat-treatment chamber, an outside door for an opening in said furnace through which charges may be inserted into or removed from said furnace, a door frame for said door forming part of said furnace, and having a plurality of spaced threaded apertures, plugs in said apertures in the nature of spark plugs but having a resistance wire across its electrodes adapted to become hot when electrically energized, said door frame being metallic whereby said wires of each plug are conductively connected together at one end, an electrical energizing circuit for said plugs including a control switch and connections to the other ends of said wires whereby said wires are electrically in parallel, operating means for said door having provisions for operating said switch while the door is being opened whereby to energize said plugs to ignite the protective atmosphere and air in contact therewith flowing into said furnace through said opening.

4. A furnace of the type in which a charge is heat-treated while enveloped by a combustible protective atmosphere, and having provisions for the admission of such atmosphere to permeate the interior of said furnace, said furnace comprising a heating chamber and a contiguous auxiliary chamber, an outer gas-impervious metallic shell for said furnace, a separating means between said chambers including an intermediate door movable within said shell as a closure for an opening in said separating means means through which the charge is transferred from one chamber to another, an outer door for an outer opening in said auxiliary chamber through which charges may be inserted into and removed from said furnace, interlocked operating means for said doors whereby one door can be opened only while the other is closed, electrical igniting means in proximity to said outer opening, including an electrical energizing circuit under control of said interlocked operating means for energizing said igniting means when the said outer door can be opened whereby any protective atmosphere and any air mixing therewith that may flow into said auxiliary chamber when the said outer door is opened or open are ignited before any explosive mixture of them reaches the heating chamber.

5. A furnace of the type in which a charge is heat-treated while enveloped by a combustible protective atmosphere and having provisions for the admission of such atmosphere to permeate the interior of said furnace, said furnace comprising a heating chamber and an auxiliary chamber contiguous thereto, an outer gas-impervious metallic shell for said furnace, said shell having a bottom defining the bottom of said auxiliary chamber, a separating means between said chambers including an intermediate door movable within said shell as a closure for an opening in said separating means through which a charge is transferred from one chamber to another, an outer door for an outer opening in said auxiliary chamber through which charges may be inserted into or removed from said furnace, door-operating mechanism for said doors, electrical resistor means capable of becoming hot when energized in proximity to said outer opening, a manually-operable lever system pivoted on the outside of said shell, means attached to said lever system and operable thereby always to lock one or the other of said doors in closed position while permitting the other door to be operated by said door operating mechanism, an electrical energizing circuit for said resistor means, and means to control said circuit to energize said resistor means when said lever system is in a position permitting said outer door to be opened where to ignite protective atmosphere and air that may flow into contact therewith through said outer opening.

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